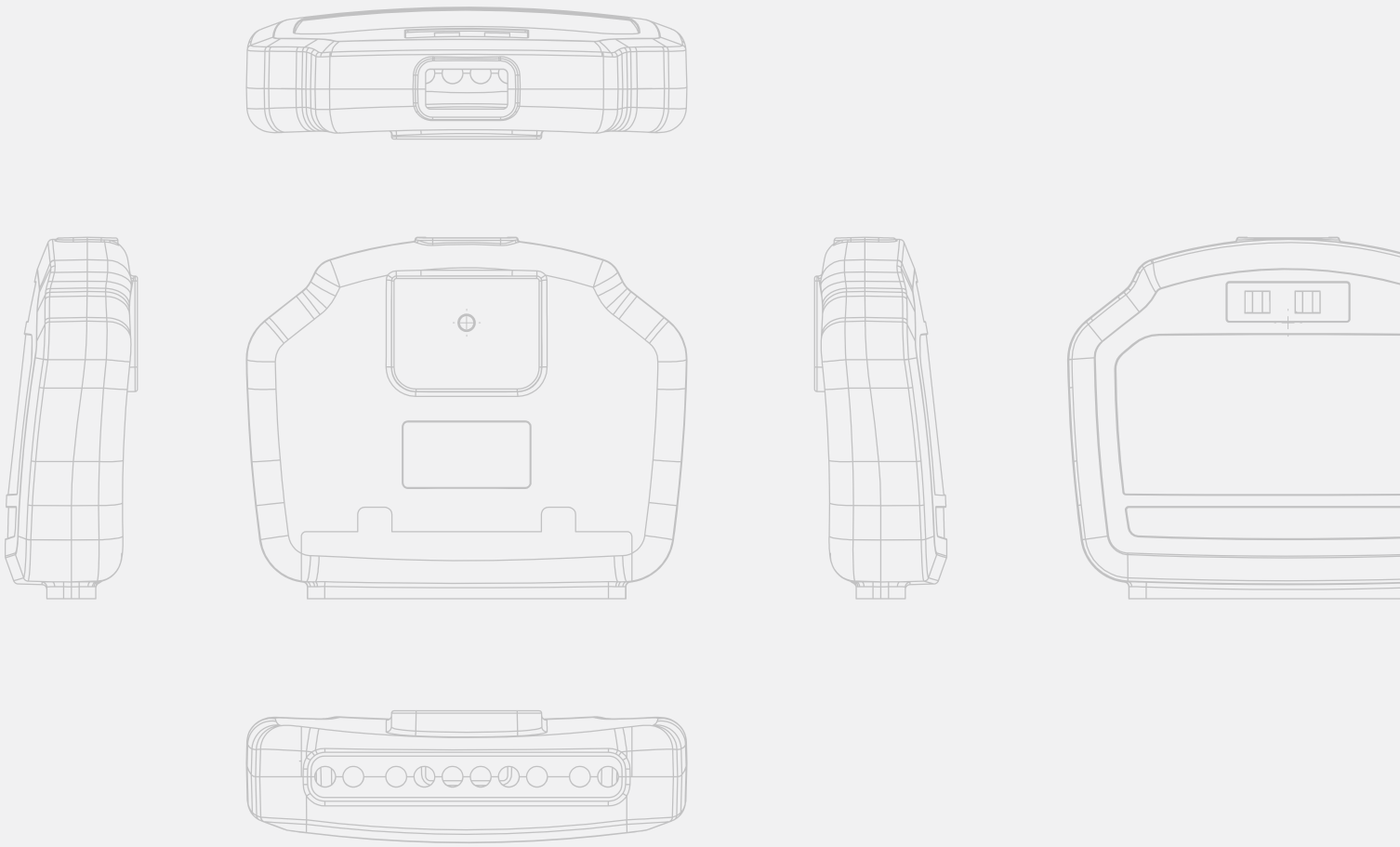
SERVICE MANUAL

Decapus® III



Quickels®

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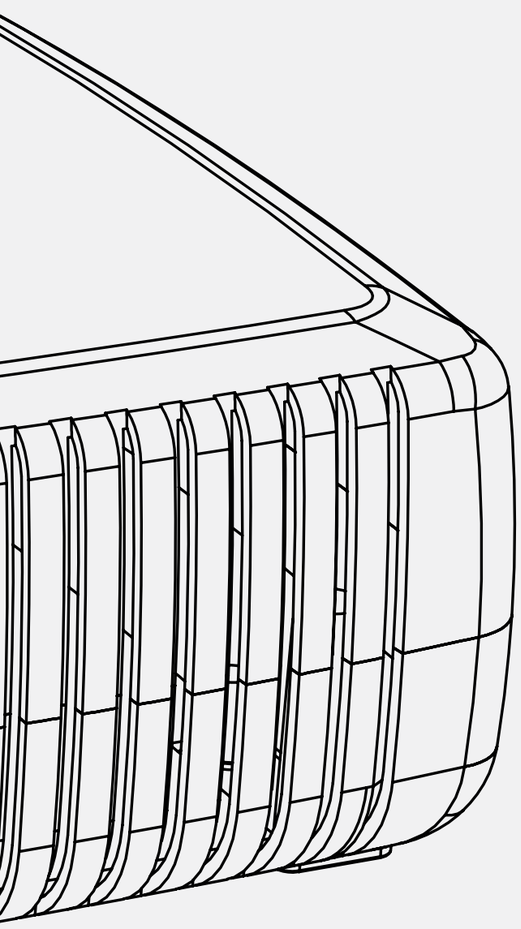

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About the Service manual

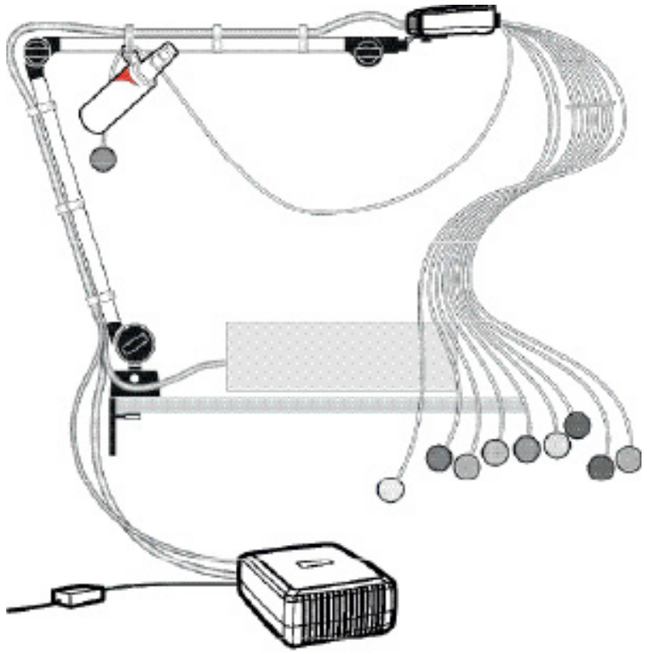
The Service manual is part of the documentation available for Decapus® III and is intended for those who work as service technicians or similar at health care centres, hospitals or private clinics and is responsible for servicing and maintenance of the system. The manual provides information on what you need to know about safety, installation and how to use the system.

Other available documents concerning Decapus® III is the User manual Decapus® III and QuickGuide™ Decapus® III.

Terminology

AUSCULATION	Monitoring of body sounds for medical diagnosis.
PATIENT LEAD	The signal is derived by measuring the voltage between two points (on body).
MOTHER BOARD	Central control unit.
DEFIBRILLATION	A method where a patient's heart is exposed to electric shock with a excitement around 5 kV.
ECG	Electrocardiography.
ESD/ECD	Electrostatic Discharge.
DIATHERMY	A technology to burn away tissue by using a high frequency voltage of about 7.5 kV.
PID	Proportional, Integral and Derivative (regulator).
PWM	Pulse width modulation, pulse width modulation, a square wave of fixed frequency where the part of the period of time the signal is high (and low) can be varied.
I²C	Inter-Integrated Circuit, a synchronous serial multi- master bus to couple low frequency units to the motherboard.

This is Decapus® III



Decapus® III is hygienic, easy to use and time saving. The system has all the advantages that are normally associated with vacuum application, but lacks the disadvantages.

Vacuum-ECG with flow compensated negative pressure prevents the negative pressure from significantly exceeding the level selected on the patient module. Double filters efficiently prevent fluid-borne contaminants from being sucked into the system and causing an obstruction.

The easily exchangeable Quickels electrodes can be replaced as necessary, which means that from a hygienic point of view Decapus® III is comparable to adhesive electrodes. In special situations, the signal modules can easily be replaced with adhesive electrodes.

UNIQUE SIGNAL MODULE AND FILTER
What makes Decapus® III unique are the patented signal modules and Quickels electrodes. Quickels electrodes are easy to attach to the patient's skin. Decapus® III automatically maintain the chosen negative pressure level, even if leakage occurs and air gets in. This means that Quickels electrodes stay fastened and give a good contact, with little risk of the patient feeling uncomfortable or getting suction marks. The primary filter in Quickels electrodes is a super absorbent and can absorb up to 1 ml of fluid.

The secondary filter, which is in the signal module, provides further protection and never needs changing.

Quickels Systems AB's innovations in the Quickels electrodes and signal modules make Decapus® III a hygienic and reliable system that seldom needs to be shut off to clean blocked signal modules or patient cables. The reinforced patient cables with high tensile strength to ensure good signal quality over long periods. The system is defibrillation protected.

BATTERY OPERATION MEANS FREEDOM
Decapus® III has a battery operation with built-in charger as an optional extra, which makes it completely mobile. The battery is a lithium-ion type giving a long operating period (4 hours) and a fast charging cycle (2 hours).

Important safety information

Decapus® III is marked with this symbol. This is the international warning symbol to indicate that use of the equipment may be dangerous. It is therefore important that you read this user manual carefully.

Before any equipment is used, the operator must ensure that there is no sign of damage.
Take any necessary action if:

- Fluid has been spilled onto the system.
- The cover or casing is split, damaged or missing.
- Cables or connectors show signs of damage.
- The system has suffered possible mechanical damage, e.g. fallen on the floor.

Safety precautions should be taken when ECG measurements are to be taken from patients fitted with a pacemaker or other electric stimulator.

SAFETY CLASSIFICATION

Decapus® III complies with the safety requirements of the International Electrotechnical Commission, publication IEC 60 601-1: Safety of Medical Electrical Equipment, Safety Classification Group I, type CF with defibrillation protection and Classification Group IIa in accordance with the Medical Device Directive 93/42/EEC.

WARNING OF POWERFUL ARM SPRING

Check that the friction screw in the middle of the arm is tight when the arm is unpacked, otherwise the arm may spring up. In the interests of safety, hold the arm together with a firm grip when the tape is removed. The arm is locked with a friction screw.

CONNECTION TO AN EARTHED ELECTRICAL SOCKET

The safety classification states that Decapus® III may only be connected to an earthed socket. Note! Connection must not be via a multi- socket extension to which other electrical equipment that does not have the same safety classification as specified above is connected.

IMPORTANT INFORMATION ABOUT RADIO TRANSMISSION EQUIPMENT ETCETERA

Decapus® III complies with the EMC requirements of IEC 60 601-1-2. Radio transmission equipment etcetera must not be used in the vicinity of the apparatus, since this could affect its function. Special care must be taken when using powerful interference sources such as for diathermy and similar, and also ensure that diathermy cables etcetera are not located on or near the Decapus® III. In case of doubt, please consult responsible personnel, or the supplier.

CONNECTION TO ECG PRINTERS AND MONITORS

The Decapus® III printer cable may only be connected to:

- ECG printers and monitors that comply with Medical Device Directive 93/42/EEG and are defibrillation protected, type CF, according to IEC 60 601-1.
- Decapus® III must not be connected to ECG printers and monitors of Safety Classification B, according to IEC 60 601-1.
- Decapus® III may only be connected to ECG-printers and monitors which are defibrillation protected with either ≤10 kOhm or ≤5 kV and 400 J.

Important safety information contd.

SYSTEM CONSTRUCTION

Decapus® III is a system made up of modules. What is stated in this User manual about safe use assumes that Decapus® III is used in its entirety, i.e. that no part of Decapus® III is replaced with other equipment. The same applies to all the system's cables. Decapus® III must only be used as a vacuum applicator for ECG electrodes in the way described in this user manual. Quickels Systems AB will not guarantee the equipment's function if it is exposed to higher levels of electromagnetic interference than it has been tested for. Quickels electrodes must be replaced at least once per day, and at least after every tenth patient, to maintain the system's function and lifetime. When Decapus® III is equipped with a lithium-ion (li-ion) battery, this must not be thrown away when reached the end of their useful life but sent for recycling.

DEFIBRILLATION PROTECTION

The symbol on the back of the patient module means that Decapus® III has built-in protection against defibrillation voltages and that the system has been tested and approved for use in connection with defibrillation. The system has been designed so that it cannot be damaged, even if the defibrillator electrodes come into contact with the Quickels electrodes. During defibrillation: never touch the patient or any other conductive item that is in contact with the patient.

EXPLOSION RISK

Decapus® III is not designed for use in locations where there is an explosion risk.

FIRE AND EXPLOSION HAZARD

Decapus® III contains a li-ion battery as an option. Only replace the battery with the type specified.

WARNING!

You must read the user manual before using the system.

Conductive parts of patient cables, Quickels electrodes and signal modules, including the neutral leads and the electrode, must not come into contact with other conductive parts, including earth protection.

The USB input must only be connected when Decapus® III is being serviced, i.e. never when the system is near or connected to a patient.

CURRENT LEAKAGE

The patient module cables are galvanically insulated from the pump module and from earth, guaranteeing that electric current through

Important safety information contd.

the patient is kept at a safe level. If a Quickels electrode, the ECG connector or the patient cables come into contact with other conductors, there is a risk of patient shock. This applies whether the object is earthed or not. No equipment not approved by Quickels Systems AB may be connected, or there is a danger of current leakage occurring. If other electrical equipment, which is not classified according to the above, is used in the same premises or in the vicinity of the patient, appropriate precautions must be taken.

CLEANING

Cleaning should be made daily.

- Cleaning should be carried out only with a damp cloth and mild detergent (soap solution or washing-up liquid). Wipe dry afterwards.
- If necessary, disinfect with a cloth soaked with 70% alcohol or surface disinfectant. Wipe dry afterwards.
- None of the equipment should ever be immersed into fluids of any kind. Nor should liquid be sucked through the system.
- No part of the system should ever be hot-sterilised with water, steam or hot air. Nor should ether be used.

If it is decided to use the same Quickels electrodes on more than one patient, clean and disinfect by wiping with a cloth dampened with 70% alcohol.

PREVENTIVE MAINTENANCE

For safe and trouble-free use of Decapus® III, preventive maintenance is required at least once a year as follows:

- Inspection for visible damage.
- Inspection of the arm.
- Inspection of cables.
- Check on power supply and functional earthing.
- Check for current leakage.
- Checking the pump module’s vacuum functions.
- Checking the signal modules’ valve and filter functions.
- If the system is equipped with a battery: Check battery and charger.

Rectify any faults. If in any doubt, consult authorised service personnel.

For more information please see the Service manual Decapus® III.

Important safety information contd.

SERVICE

Repairs to Decapus® III or service measures if Decapus® III is not working must be performed by Quickels Systems AB or our appointed and authorised agents (see www.quickels.com). If any parts are replaced, original spares must be used. Measures carried out must bedocumented showing what has been done, when, where and by whom (company and signature).

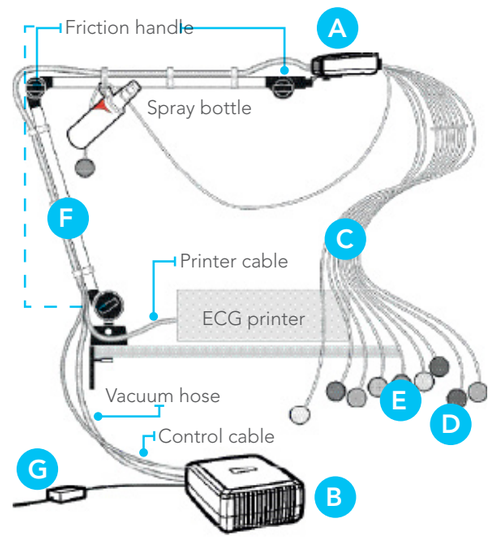
WASTE HANDLING

At the end of their useful lifetime, the product and any replaced parts must be treated as electronic waste (WEEE) in accordance with the local system for recycling. Other materials such as paper and plastic are recycled as such. Contact your local authority or the supplier for more information.

Key to symbols

CE	CE label		Off/on	NON STERILE	Non-sterile
	Recycling		Service needed		Dispose of as electronic waste
	Follow the manufacturer's instructions		Connected to the mains		Keep dry
	Protection for defibrillation voltage		Battery status, 4 levels	REF	Catalogue number
	Caution	SN	Serial number		Date of manufacture
	Warning	LOT	Batch code		Manufacturer

Decapus® III system design



Decapus® III consists of pump module, patient module, power supply, control cable, vacuum hose, recorder cable, patient cables, signal modules, Quickels electrodes, table fixation and arm.

PATIENT MODULE A

Decapus® III is controlled from the control panel on the patient module. The control cable and vacuum hose connect the patient module with the pump module (B). The recorder cable connects to an ECG printer.

PUMP MODULE B

The pump module includes vacuum pump, silencer, vacuum and pulsation dampers, control electronics and (as an option) a rechargeable battery.

PATIENT CABLES C

The ten shielded, interference-free patient cables are low-friction type and are highly flexible. Like the signal modules they are clearly marked with identification complying with IEC standards. A connector, 4 mm in diameter, allows adhesive electrodes to be used.

The recorder cable must only be connected to MDD 93/42/EEG approved ECG printers of type CF according to IEC 60 601-1.

SIGNAL MODULE D

Signal module with filter that absorbs 1.5 ml of fluid.

QUICKELS ELECTRODES E

The easily replaceable Quickels electrodes contain a primary filter that can absorb 1 ml of fluid and prevents fluid-borne contamination from entering the system. The electrode itself is coated with silver/silver chloride for high signal quality.

ARM F

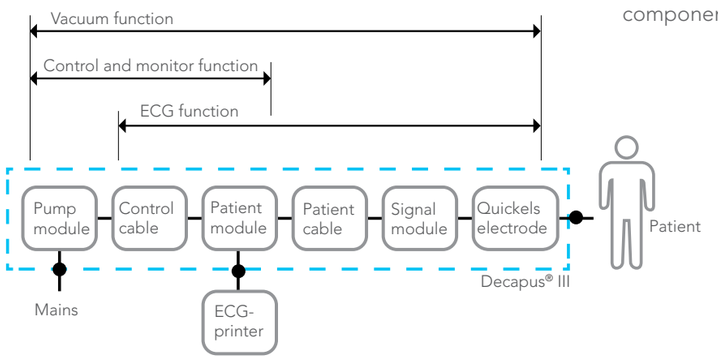
The easily adjustable arm supports the patient module and simplifies patient movement from rest to stress position. Arm movements are adjusted using the three friction screws.

POWER SUPPLY G

Connects to an earthed mains supply.

Pump fastening, other arm fastenings and ECG-adapters for ECG printers are available as accessories.

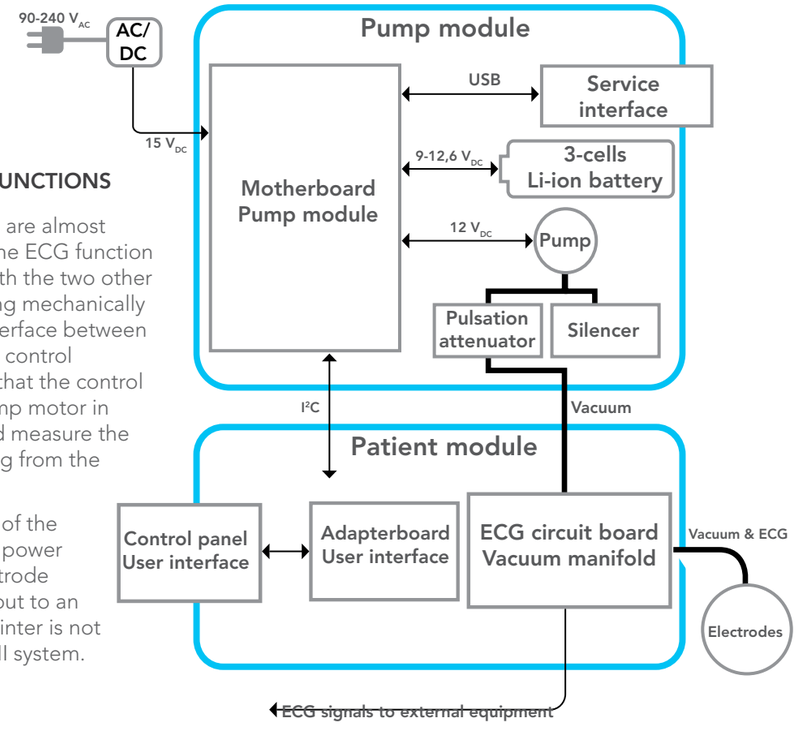
Technical description



THE SYSTEM'S MAIN COMPONENTS

The three main functions works by a combinations of the three individual components.

- Vacuum function - to fixate the Quickels electrodes on the patient by regulating the vacuum.
- ECG-function - to detect and convey ECG signals from the patient to an external ECG printer.
- Control and monitor function - to monitor and control the vacuum function and the input from the control panel.



THE SYSTEM'S MAIN FUNCTIONS

The three main functions are almost completely separated. The ECG function have no other contact with the two other functions other than being mechanically packed together. The interface between the vacuum function and control function consists only in that the control function controls the pump motor in the vacuum function, and measure the pressure in a hose coming from the vacuum function.

The external boundaries of the system are confined to a power supply, a number of electrode signal inputs and an output to an ECG printer. The ECG printer is not a part of the Decapus® III system.

Technical description, contd.

ENERGY SAVING MODE

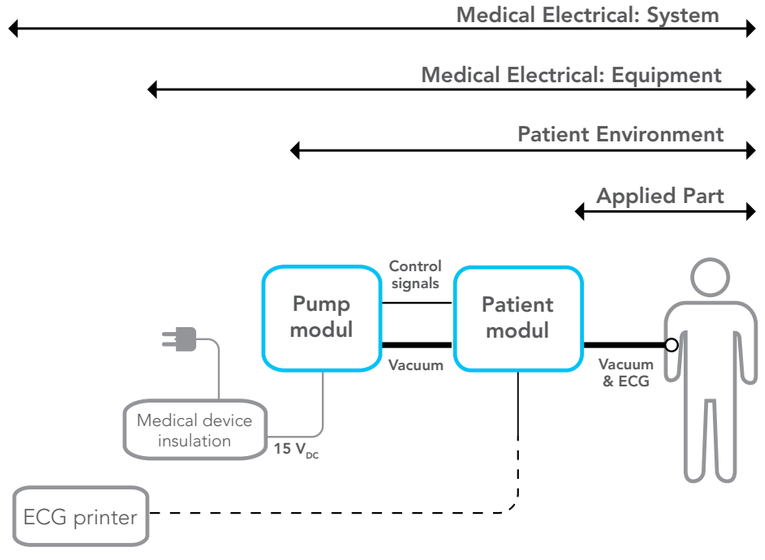
Decapus® III has a microprocessor, and to save energy the system is equipped with an energy saving mode. The energy saving mode is activated only when the system runs on battery, not when connected to the mains.

If Decapus® III does not get any signal input from the control panel during a 60 minutes period, the system is idle. To wake the system, press any button on the patient module's control panel.

If the control cable has been unplugged from the pump module, it can take up to 20 seconds before booting the system from its idle mode.

REGULATORY BOUNDERIES

The regulatory bounderies between the parts of the system.



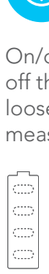
Patient module

The parts

The patient module consists of a control panel, control electronics and a defibrillation protector. The control panel has touch buttons and is easy to use and clean.

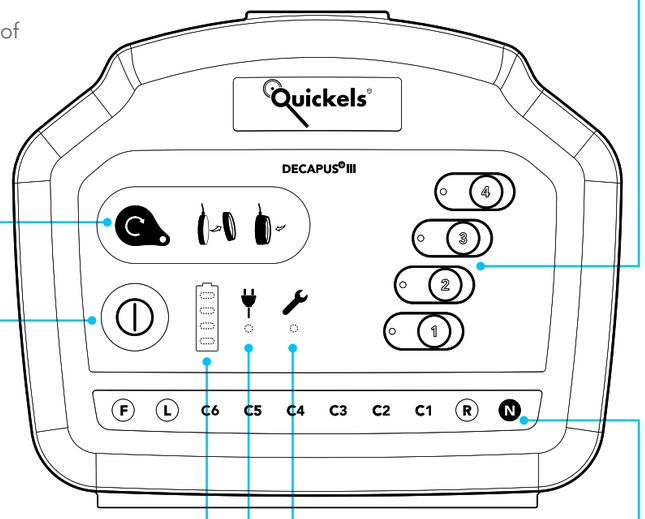
Indicator for electrode change (after 10 measurements). Button for acknowledgement of replacement.

On/off button to shut off the vacuum pump to loosen electrodes after measurement.



Battery operation and charging status indicator.

Mains power indicator.



4 buttons for setting desired negative pressure.

Marking panel for leads.

Service needed indicator. Contact authorised service technician.

CONTROL SIGNAL

When a certain vacuum level is selected on the control panel the motherboard initiates a control signal to the vaccum pump, the pump creates a vacuum.

The mother board also contains a pressure gauge which measures the pressure in a hose branched from the vacuum pulsation damper. The signal from the pressure gauge moves on to the processor block, comparing the pressure with that from the selected vaccum level on the control panel. The processor block regulates the control signal to the vacuum pump, so that the selected underpressure is obtained. The controller in the processor block is of the PID type.

Patient module, contd.

FLOW COMPENSATION

The flow compensation is executed by measuring deviations from the nominal pwm signal for a certain selected vacuum level of processor block and interpreted as there is a leak somewhere. The processor block increases the PWM signal to compensate for the pressure drop that occurs from the Quickels electrode to the pressure gauge.

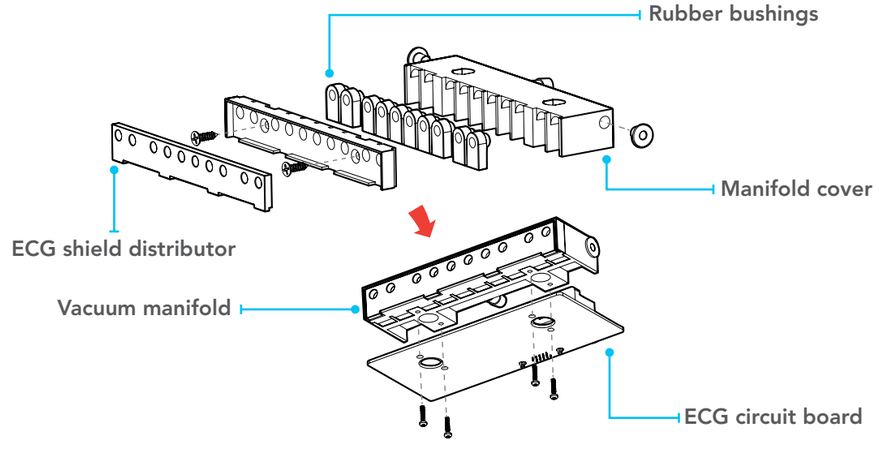
The pump motor is stopped when the on/off button on the control panel is pressed or when one hour has elapsed since the last time any button on the control panel was pressed down.

VACUUM MANIFOLD & ECG CURCUIT BOARD

The negative pressure that is selected on the control panel are distributed through rubber bushings to the patient cables and on to the electrodes. The ECG signal detected from the patient is transmitted back through the patient cables, and linked to the ECG circuit board via rubber bushings. The shield on the patient cables is connected via the ECG shield distributor to the ECG circuit board.

The ECG circuit board has built-in protection for defibrillator voltages and it is constructed so that it can not be damaged, even if the defibrillator pads are in contact with the Quickels electrodes.

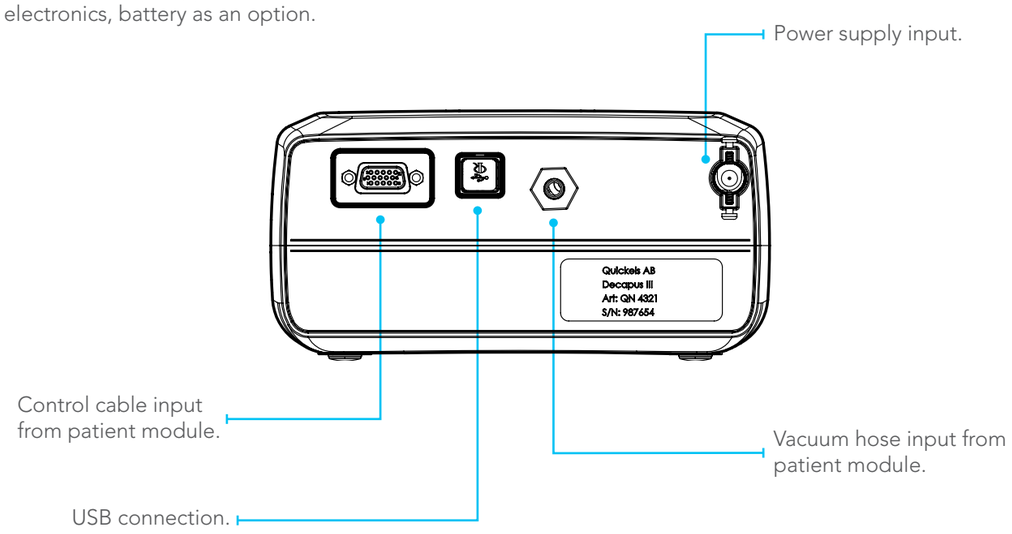
Leakage in the patient module, may be due to old rubber bushings, see section *Troubleshooting*.



Pump module

The parts

The pump module includes vacuum pump, silencer, pulsation dampers, pressure sensor and control electronics, battery as an option.



Never connect to anything other than the intended power supply!

Only connect with Decapus® III patient module!

The USB input must only be connected when Decapus® III is being serviced, i.e. never when the system is near or adhered to a patient.

Li-ion battery. Fire and explosion hazard!

Never use any other kind of battery!

The battery may only be replaced by a qualified service technician.

Pump module, contd.

VACUUM FUNCTION

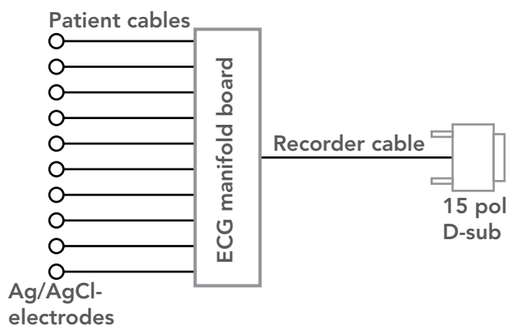
Decapus® III is equipped with a high performance vacuum pump with dual heads. Maximum vacuum is ≥ - 700 mbar. Free flow rate is ≥ 8 l/min.

The main task of the vacuum function is to provide a controllable pressure in the signal module and Quickels electrodes so that these can be attached to the patient and provide a good electrical contact, without dirt and sweat to be taken into the system. For more information see section *Patient module, Control signal*.

ECG-FUNCTION

The main task of the ECG function is to detect ECG signals from the patient and convey these to an externally connected ECG printer. The ECG function is defibrillation proof.

Ag/AgCl sensor element in the Quickels electrodes are attached to the patient via the negative pressure. The signals transduced by the electrodes is transferred by the shielded patient cables to the ECG manifold board in the Patient Module. This is the protection against defibrillation and diathermy. Both the ECG printer and the recorder cable must be protected from the high voltages which occur during defibrillation (~5000 V) and diathermy (~7500 V). The protection consists of serial resistors to limit current and gas discharge tubes that limits voltage. The signals from the electrodes are transferred via the shielded patient cables to the ECG manifold board, from the ECG manifold board the signals are then transferred via a shielded low noise trunk cable (10-core) (recorder cable) to a 15-pin D-sub connector that connects to the ECG printer.



Pump module, contd.

BATTERY AND CHARGING

The battery power (optional) means the Decapus® III can function as a completely mobile system. Charging the battery is done automatically when the system is connected to the mains. The life time is around 400 charging cycles. The battery charging time is about 2 hours and the runtime is about 3.5 hours, which corresponds approximately to:

- 50 resting ECGs (5 min per round).
- 10 ECG stress tests (20 min per round).

The battery status is indicated on the control panel by four modes:

- Green continuous light in fields 1-4 indicates the charging level of the battery.

- Orange flashing light in the lower battery field indicates low battery. The system should be connected to a grounded mains outlet for recharging after use.

- When the battery power reaches the minimum level the system shuts down and flashed with an orange light when the operator presses any button on the control panel.

- A flashing green light indicates that the battery is charging.

When the Decapus® III is used for the first time after delivery, the system shall be connected to the mains in order to ensure that the battery is charging, indicated by green flashing light on the control panel. This is because the battery on delivery is set in a sleep mode and need to be activated. The same applies when changing the battery.

When the system runs on battery without mains connected, the pump starts when the vacuum level is selected with the buttons 1- 4 on the control panel. If the vacuum pump, on battery power, is left on by mistake, the system automatically shuts down after 1 hour. If the battery should become completely discharged, the system provides no feedback at all. By connecting the system to the mains the battery can be recharged and Decapus® III can be used again .

In case of malfunction of the battery, the service lamp lights up on the patient module, see section *Service application (PC).*

If Decapus® III is connected to the mains and the indicator for mains power is lit on both the power supply and the patient module, but the battery will not charge (indicator on the patient module is not flashing), unplug the power mains cable from the wall socket and re-plug it again.

For more information, see section *Troubleshooting guide.*

Signal modules and electrodes

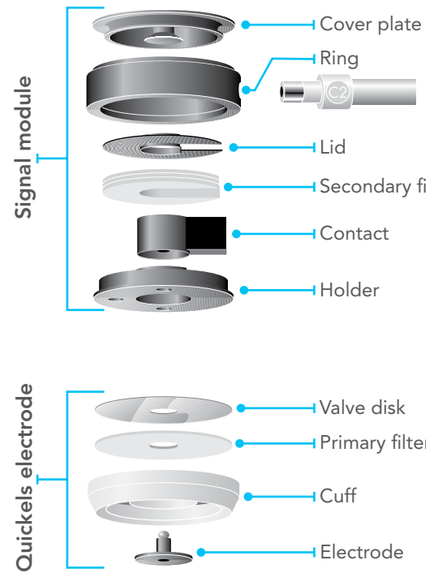
SIGNAL MODULES AND QUICKELS ELECTRODES

The air sucked into the system may contain fluid-borne pollutants, for this not be sucked into the system the Quickels electrode consists of a barrier, the primary filter, that may absorb up to 1 ml of liquid. When the primary filter has absorbed 1 ml of liquid the airflow is stopped because the primary filter blocks the vacuum and the Quickels electrode can not be attached to the patient. The Quickels electrode contains an electrode sensor coated with silver/silver-chloride to permit high signal quality. The secondary filter in the signal module provides additional protection against moisture, liquid and impurities sucked into the rest of the vacuum system. It can absorb up to 1.5 ml of liquid.

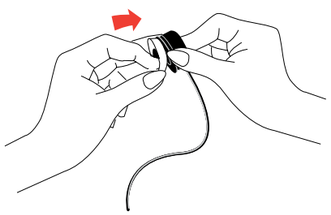
SIGNAL MODULES

The signal module consists of a valve housing of silicon rubber, a holder with a cover, a connector of electrically conductive silicone, and a secondary filter. The patient cable and the electrode are connected to the contact. Note that the function of the valve housing is dependent on the use of the correct Quickels marking disk.

It opens by pressing lightly on the signal module.



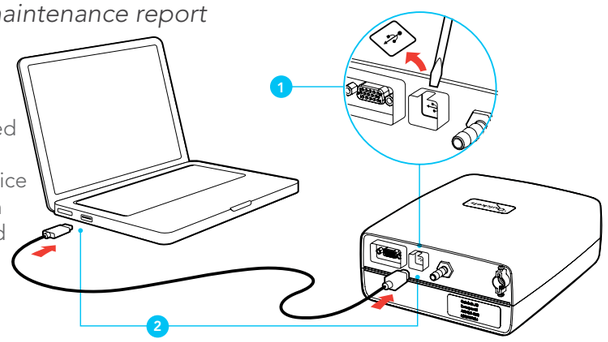
Electrodes should be replaced after every 10 measurements, which is indicated by a diode on the front of the patient module.



All 10 electrodes in the system must be changed at the same time.

Service application (PC)

Decapus® III is equipped with a Service application (supplied USB stick) to facilitate service, preventive maintenance and possible troubleshooting of the system. The Service application stores test data and by using the associated ServiceGuide, a *preventive maintenance report* in pdf-format, can easily be printed.



On the short side of the pump module an USB port is located (2) to which a PC can be connected (Windows operating Systems XP/7/8), enabling direct troubleshooting of the system via the Service application, thus obtaining recommendations on the system's fault status. The USB cap is removed by the use of a small screwdriver (1).

Do the following:

- Patient module shall be connected.
- Decapus® III must be connected to the mains.

The Service application can be used without using the ServiceGuide to obtain test values and information about the system, but by using the ServiceGuide a printable pdf-report can be generated.

The Service application and software (firmware) can also be downloaded from the Website; www.quickels.com, but the files must be saved to your computer before they can be used.

SERVICE TESTS

Open up the *Service application.exe* program on your computer.

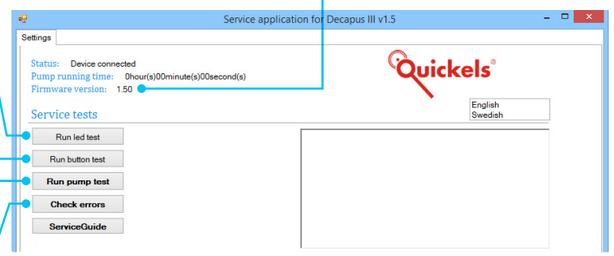
Run led test: The led test lights all LEDs on the patient module enabling an ocular inspection.

Run button test: Follow the instructions in the informations box to check the function on each individual button. If you wait more than 10 seconds before you press the button, it will be recorded as an error.

Run pump test: Checks the vacuum function of the system. The Service application tests each vacuum level, every four seconds and returns the measured vacuum levels in the information box.

Check errors: If the service needed indicator lamp on Decapus® III is lit, the error is shown in the information box. See section *Possible error messages in the Service application.*

Firmware version: States the firmware version used in your Decapus® III.



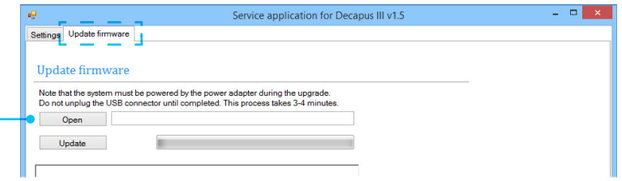
The USB port must only be connected to when Decapus® III is being serviced, that is never once the system is near or connected to a patient.

Service application (PC), contd.

SERVICE SETTINGS

In order to access service settings and related features, you must be logged into the Service application:

USER NAME: service
PASSWORD: qsdiii2014


Service application for Decapus III v1.5
Settings
Update firmware
Update firmware
Note that the system must be powered by the power adapter during the upgrade.
Do not unplug the USB connector until completed. This process takes 3-4 minutes.
Open
Update

Update firmware: You need a .hex-file to update the systems firmware. Then *follow the instructions* in the information box.

The software can be found on the supplied USB stick or www.quickels.com. Note that if you download the files via the Website, these must be saved to your computer before use.

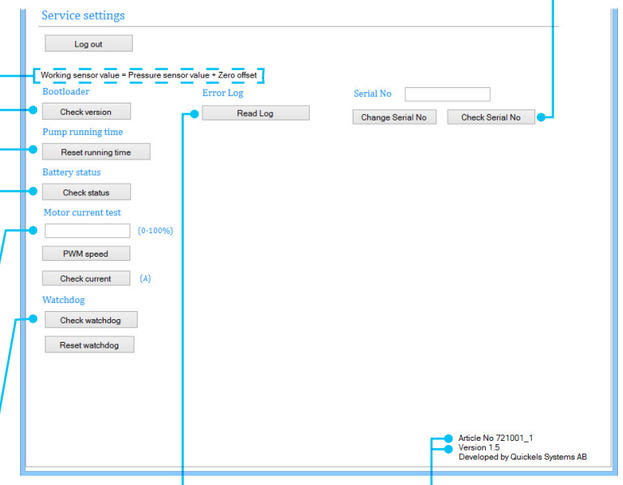
Working sensor value (at normal air pressure 1.0 Bar): Working sensor value is the ameded pressure sensor value.

- The pump function should be turned off.
- The value must be **2.83 ± 0.05 V**.

If the value differ, the system must be calibrated by changing *Zero offset* and *run calibration* so that the *working sensor value* becomes 2.83.

Serial No: State the serial numbers of the system.

Note! This may *only be changed* if the system is replaced with a new motherboard that needs to be loaded with the system's existing serial number. See section *Repairs and parts replacements, 4. Replacing the motherboard.*



Bootloader: Shows the version of a particular part of the software in Decapus® III.

Pump running time: Shows how long the system has been running since start/previous reset. The time is displayed on the upper left corner.

Battery status: Parameters to consider in the information box is *battery voltage, number of cycles* and *absolute charge*, which indicates the health status of the battery. If the cycle count is more than 350 cycles, the battery should be replaced.

Motor current test: Measurement of the system's power consumption. The AC adapter should be connected. Set to 100%, press the PWM speed button. The current consumption of the pump is shown in the information box. Is the result over 3.5A, it indicates that the vacuum pump is worn out and need to be replaced.

Watchdog: Monitors how many times the processor has been restarted; many reboots may indicate errors in the system. Contact Quickels Systems and inform about this.

Article No: Shows the article number of the Service application.

Version: Shows the version of the Service application.

Error log: State errors recorded by the system.

Service application (PC), contd.

SERVICEGUIDE

The ServiceGuide is a step-by-step guide intended to ease possible troubleshooting and the yearly maintenance, see section *Annual service*. For other matters such as installation, repair and more specific troubleshooting, see the relevant section in this service manual.

By using the ServiceGuide two different types of tests can be performed:

- Troubleshooting ⟶ Troubleshooting report
- Preventive Maintenance (PM) ⟶ PM-report

This is selected in the drop down list under the tab *General Information*.

The ServiceGuide is operated by clicking on the icons in the lower right corner. You can at any time go back to a previously answered page by clicking on its tab in the upper left corner.

Tools: Fill in used tools and equipment.

Extrernal Checks: Inspection of the system, click OK/Adjusted/N/A.

Data collection: The ServiceGuide retrieves data from the Service application. Wait until the collection is complete.

System Test: Retrieved data from previous step is shown here.

NOTE! If the working sensor value differs from 2.83 ± 0.05 V, the system must be calibrated, see section *Service settings* above.

Led Test: The led test lights all LEDs on the patient module. Be sure to click OK/Not OK.

Button Test: Follow the instructions in the information box to check each individual button. The ServiceGuide via the Service application returns OK/Not OK.

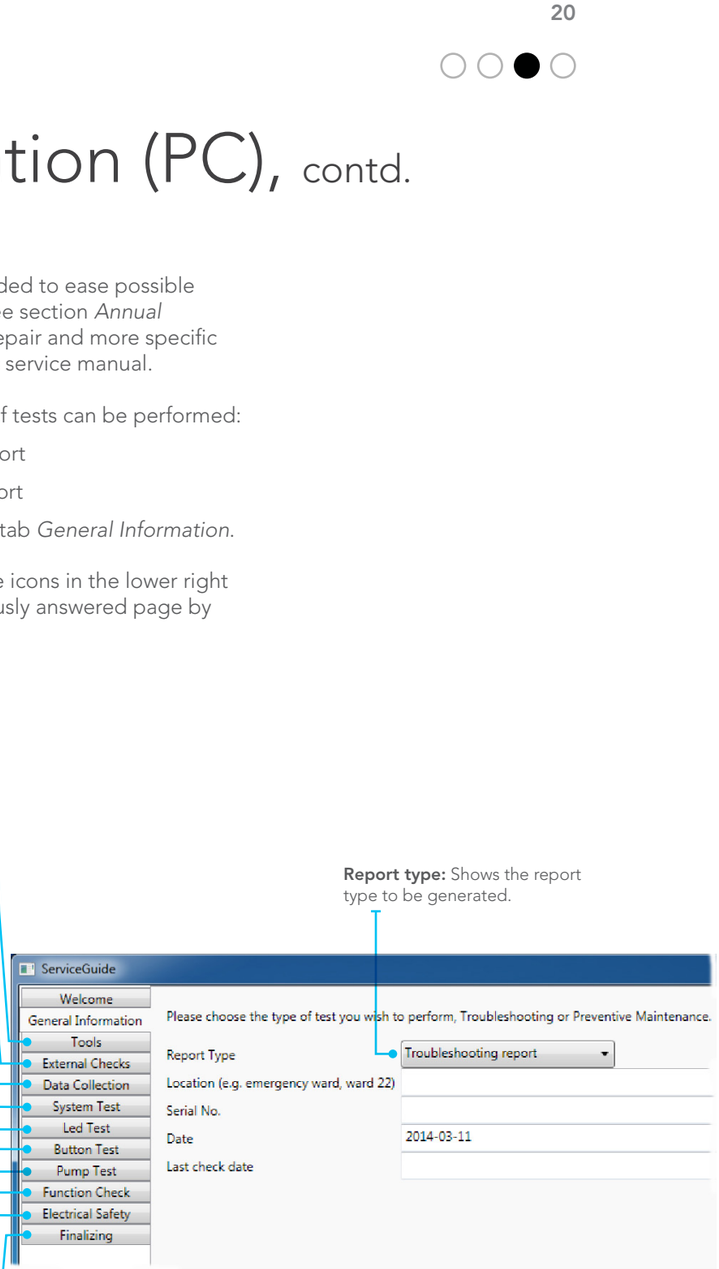
Pump Test: Checks the function of the vacuum pump. The Service application tests each vacuum level every four second and returns OK/Not OK as well as the present vacuum level. Perform the flow test with external eqiupment, be sure to click OK/Not OK as well as fill in the results. Approved if the flow is ≥ 6 litres/min.

Function Check: Perform the tests with external eqiupment, e.g. Quickels Systems AB's Measuring instrument (QN D750). Be sure to click OK/Not OK as well as fill in the results. See section *Measruing instrument (QN D750)*.

Electrical Safety: Perform the tests with external eqiupment, e.g. Quickels Systems AB's Measuring instrument (QN D750). Be sure to click OK/Not OK as well as fill in the results.

Finalizing: Fill in any final comments and who performed the test. Click *Save PDF*.

Report type: Shows the report type to be generated.



Service application (PC), contd.

POSSIBLE ERROR MESSAGES IN THE SERVICE APPLICATION

MOTOR PUMP ERROR	Indicates that the vacuum pump in the pump module may be faulty. Restart Decapus® III and activate vacuum level 4. If the error recurs, the pump motor and its cablings must be inspected and replace if necessary.	See section *Pump module*. When replacing, se section *Repairs and parts replacement, Pump module, 4. Replacing the circuit board (motherboard).*
PRESSURE SENSOR ERROR	Indicates the pressure sensor on the pump module motherboard may be faulty. Restart Decapus® III and activate vacuum level 4. If the error recurs, the motherboard needs to be replaced.	See section *Pump module*. When replacing, see section *Repairs and parts replacement, Pump module, 3. Replacing the vacuum pump.*
MAINS ERROR	Indicates that the power supply that is connected to the power supply input on the pump module deliver incorrect output voltage. Verify that the correct power supply is used. Disconnect the power supply and restart Decapus® III (if it has battery power). Plug in the power supply and wait 1 minute to see if the error recurs. If the error recurs, check the output voltage of the power supply, which shall be 15 ± 0.5 VDC. If it deviates, the power supply must be replaced.	When replacing, see section *Repairs and parts replacement.*
BATTERY: -PF STATUS ERROR -FET STATUS ERROR -SAFETY STATUS ERROR	Indicates that the battery's built-in security features are activated to avoid the risk of damage. Restart Decapus® III to see if the error recurs. If it recurs, the battery must be replaced. Decapus® III can be used without the battery (with power supply) meanwhile the new battery is to be delivered.	When replacing, see section *Repairs and parts replacement, Pump module, 2. Installing/replacing the battery.*

SWITCH OFF THE SERVICE NEEDED INDICATOR LIGHT

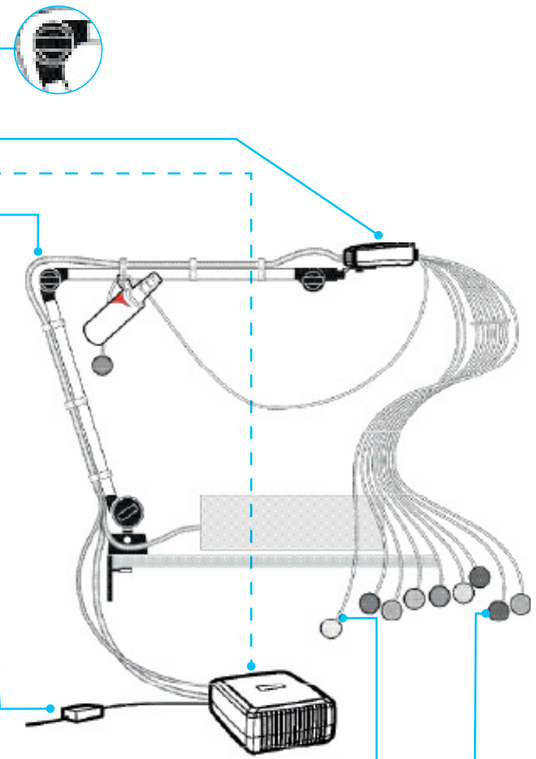
When the error indicated by the service needed indicator light on the patient module's control panel is resolved, the system must be put into energy saving mode (see *Technical description, Energy saving mode*). This is done by disconnecting the power supply from the mains and the USB cable from the pump module. If the system is equipped with a battery, the on/off-button must then be pressed until the system is put into an idle mode. Thereafter connect the power supply into the mains and press any button on the control panel to start the system.

Annual service

Arrangements of a recurring nature that should be performed to ensure continuous and trouble-free use of Decapus® III.

INSPECTION

- Ensure that no part of the system is missing.
- Check that the arm joints do not fit loosley and that the table fixation (if one is used) are steady.
- Check that the patient module casing is intact, especially where the arm is attached.
- Check that the pump module casing is intact.
- Check that the control cable, vacuum hose and recorder cable do not show visible damage, burn marks or cracks, especially where they are bent and connected to the pump module or to the external ECG printer. Also check that there are sufficient loops at the arm joints, so that the cables are not strained when the arm is bent .
- Check that the power supply and mains cable do not show visible damage, burn marks or cracks.
- Make sure the mains cable is plugged into the same earthed socket/multiple socket as the ECG printer.

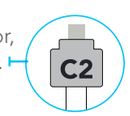


- Check the resistance of the system. (See section *Measuring instrument (QN D750)*)
- Check the insultaion of the system to shield. (See section *Measuring instrument (QN D750)*)
- Check the buttons on the patient module's control panel, by running the *Run button test.* (See section *Service application (PC)*)
- Check the the vacuum function of the pump module by running the *Run pump test.* (See section *Service application (PC)*)

  If Not OK, check for leaks in the system. Are all signal modules tightly fixed? Is the motor sound high? etc. (See section *Troubleshooting)*
- Check the battery status by running the test *Battery status.* (See section *Service application (PC)*)

Correct any faults.

- Make sure that the patient cables do not show visible damage, especially where the signal module is connected.
- Check that the signal modules do not show visible damages.
- Check the inside of the patient cable connector, so that no salt bridges are visible, replace if so.



- Update the pump module's motherboard with the latest firmware. *(See section Service application (PC))*

Measuring instrument incl flow meter
(QN D750)

The Measuring instrument provides an easy way to measure and detect if there is something wrong with ECG function of Decapus® III. If the resistance deviates much from the default value for a patient lead, this may indicate a fault condition. With the flow meter, it is easy to measure the system's airflow to find if any leakage has arisen, which affects the vacuum.

Salt bridges can occur both in the patient cable and signal module.

- The resistance between the shield and the patient lead may indicate the existence of salt bridges between the system's shield and the chosen lead. Keep in mind that the chance of detecting salt bridges is best if the system is tested when a problem has just occurred. If moisture has time to dry off the possibility of detecting salt bridges is lowered.

1. Resistance measurement

a) Connect the signal module, A, (without Quickels electrode) to respective electrode lead position. Plug the recorder cable into the D-SUB of the measuring instrument. Decapus® III does not need to be connected to the mains.

b) Set the multimeter to Ω and connect the multimeter's test leads in B (ECG End) and C (Patient Cable End).

c) Turn the knob E to the selected patient lead and record the value.

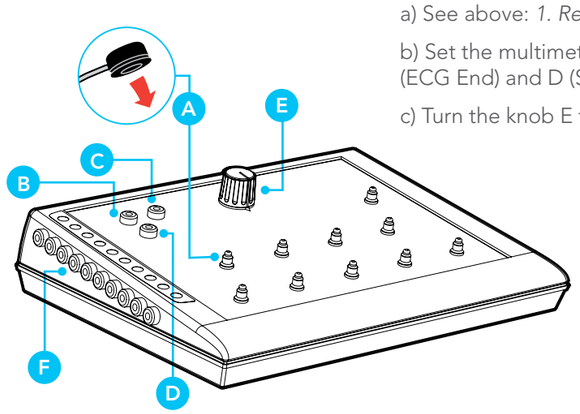
If the value of the resistance of the lead deviates much from the default value, this lead has to be investigated in more detail, see section *Troubleshooting, Resistance of the individual ECG components of the system* and *Technical data.* The error may exist in both signal modules and/or patient cable, where, for example salt bridges affects the contact and thus the signal quality.

2. Measurement of salt bridges between patient leads and shield (Isolation measurement)

a) See above: *1. Resistance measurement, a)* then,

b) Set the multimeter to Ω and connect the multimeter's test leads in B (ECG End) and D (Shield).

c) Turn the knob E to the intended patient lead and record the value.



The value should be infinitely large. A measured value of 30 MΩ or less indicates formation of salt bridges. Replace the relevant patient cable, however, the recommendation is to change all patient cables. All patient cables are probably worn out and need to be replaced.

Replace the Quickels electrodes after every 10 measurements and do not spray salt solution directly onto the Quickels electrode. By following these recommendation no salt bridges will form.

Measuring instrument incl flow meter
(QN D750), contd.

3. ECG simulation

a) Connect Decapus® III to the mains. Note that the system does not need to be energized to make an ECG simulation test, but it can be useful in order to detect possible sources of noise etcetera on the ECG signal.

b) All signal modules should be connected to respective electrode lead position, A, (without Quickels electrode). None of the multimeter test cables should be connected to the measuring instrument (B, C or D).

c) Connect the recorder cable from the patient module to the ECG printer.

d) Connect the ten laboratory cables (can be purchased with QN D750) from the ECG simulation box (or similar) in the correct socket position on the measuring instrument's left short side, F.

e) Start the simulation and check the ECG signal.

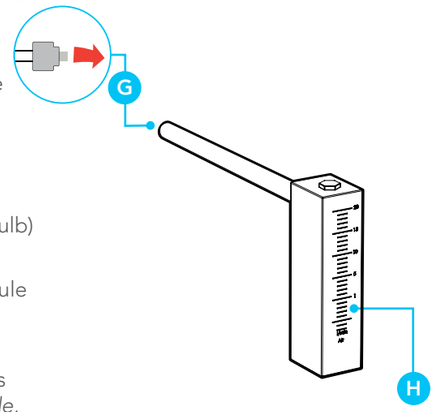
In case of deviations, see section *Troubleshooting Guide* and *Interference on the ECG trace*.

4. Flow measurement

The system's airflow can be controlled by using the flow meter.

a) Connect Decapus® III to the mains and ensure that the flow meter is stable on a flat surface.

b) Make sure that the signal module is properly connected to each patient cable (no gap), except for one. The end of the patient cable lacking the signal module is pressed into the tube, G, on the flow meter. The measurement can be done with or without Quickels electrodes.



c) Start the vacuum by pressing the vacuum level 4 button on the patient module's control panel and read the value (bottom of the bulb) with the help of the grading scale on the flow meter, H.

Note that you can listen at the connection between the signal module and patient cable to detect small leakages. If you hear any leakage sound, push to the signal module tighter onto the patient cable.

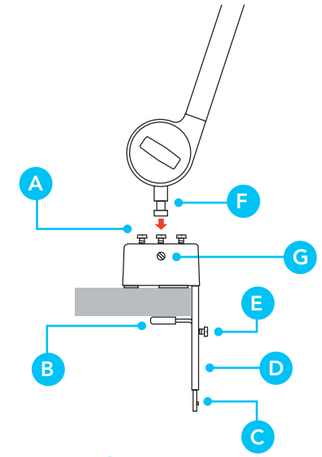
If the value of the airflow deviate much from the default value, it has to be investigated in more detail, see section *Troubleshooting guide, Leakage* and *Technical data*.

Installation

1. Patient module and arm

a) Attach the arm in the trolley's or the supplied fixation. If Quickels Systems AB's table fixation is used - se mounting instructions below.

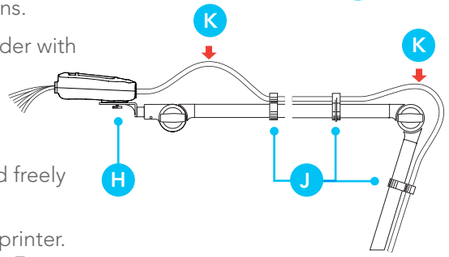
- Loosen screws A to uppermost position without detaching. Adjust position of counter-arm B to the thickness of the table. If necessary turn up-side down.
- Ensure that studs C fit into hole D.
- Tighten fixing screws E.
- Tighten screws A so that the bench clamp is properly anchored to the table.
- Press the shaft-stubb for the arm F all the way down into the foot.
- Friction screw G retains/adjusts.
- Check that the installation tolerates loading in all directions.



b) Assemble the patient module onto the patient module holder with screw H.

c) Attach the control cable, recorder cable and vacuum hose to the arm with the 6 cable clips, J.

d) Install the cabling according to K, so the arm can be moved freely without the cables being stretched or pinched.

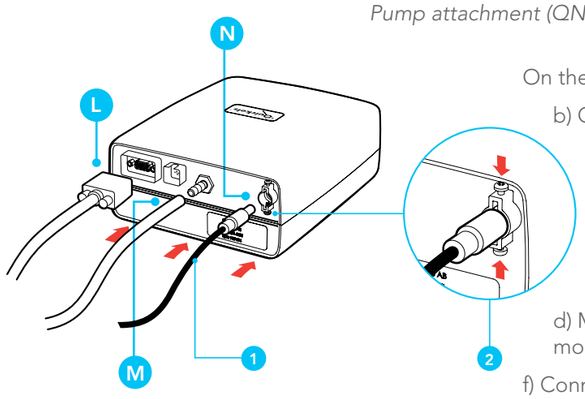


d) Connect the recorder cable (DA-15) into the external ECG printer. For ECG printers with other input than D-SUB, see *5. Adapter*. For more information, see the ECG printer manual.

Make sure that the recorder cable (DA-15) is not in direct contact with the energized mains cable. Also, remove as far as possible, energized cablings in the patient environment, see section *Technical description*.

2. Pump module

a) Install the pump module on the correct position. If Quickels Systems AB's pump attachment is used - see installation instructions for *3. Pump attachment (QN D701)*.



On the short side of the pump module:

b) Connect the control cable to the D-SUB-input, L.

Make sure that no energized cable comes in direct contact with the control cable.

c) Attach the vacuum hose to the nipple, M.

Make sure that no cables or hose can get caught if the system needs to be moved.

d) Mount the power supply to the trolley or pump module bracket.

f) Connect the mains cable to an earthed socket. The same earthed socket/multiple socket as the ECG printer.

g) Connect the DC-plug of the power supply (AFM45US15) to the pump module's DC-input, N (1), and tighten the screws (2).

Installation, contd.

i) Check that the works by assuring that the mains operation indicator on the control panel of the patient module lights up.

If the system is equipped with battery, the battery operation and charging status indicator lights up, see section *Pump module, Battery and charging*.

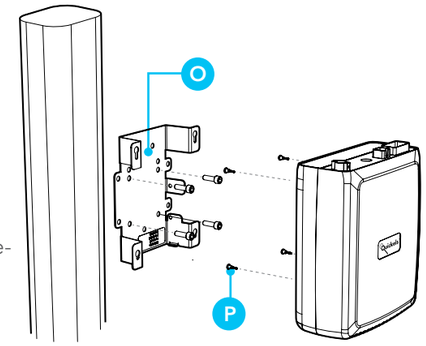
3. Pump attachment (QN D701/QN D702)

a) Quickels Systems AB's pump module bracket is screwed to the trolley by the pre-drilled holes, O.

Note that the hole-pattern of the pump module bracket is designed so that it can be attached to different types of trolleys, hence use the correct holes and screws for mounting

b) In each corner of the lower part of the pump module, there is a pre-drilled hole where screw and spacer P, shall be fasten.

See supplied installing instructions on the USB stick.

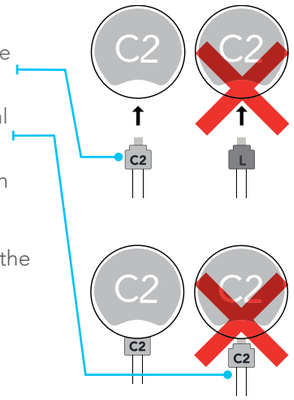


4. Signal modules and electrodes

a) If not done, fit each supplied signal modules to the patient cable with the corresponding marking.

b) Ensure that the patient cable is properly connected to the signal module with a tight fit and not being loose.

Electrodes should be replaced after every 10 measurements, which is indicated by a diode on the front of the patient module. When replacing, all 10 electrodes in the system must be changed at the same time. The acknowledgement button on the control panel of the patient module should then be pressed in.



5. Adapter (QN D305-H/QN D752)

Quickels Systems AB's adapter is used to connect the system to an ECG printer with an input other than the D-SUB input Quickels Systems AB is using.

Contact Quickels Systems AB for more information.

The adapter may only be used together with Quickels Systems AB's products and approved ECG printers.

6. Transport and packaging

When packaging the system primarily original packaging should be used. If this is not available, special care should be taken when packaging the pump module, as this contains the vacuum pump and the motherboard. These can be damaged during shipment if the pump module is packed inadequate.

Troubleshooting guide

THE FOLLOWING TROUBLESHOOTING GUIDE REQUIRES THAT YOU COMPLETE THE FOLLOWING INITIAL CONTROLS:

1. Decapus® III is connected to mains, turned on and energized from the power supply (mains fuse in the building controlled).

2. The ECG printer is plugged in, turned on and energized by the mains (mains fuse in the building controlled).

3. The recorder cable is properly connected to the ECG printer.

4. ECG printer and Decapus® III mains cables are plugged into the same earthened socket.

5. Patient cables are properly connected to the signal modules.

6. Saline solution is used as electrolyte, not water.

ERROR	CAUSE	SOLUTION
NO VACUUM	Decapus® III not connected to mains.	Connect the power supply to mains.
	The mains power indicator light is off, power supply is faulty.	Replace the power supply (QN D101).
	The power indicator on the power supply is lit, but not the mains operation indicator on the patient module.	Replace the motherboard (QN D140).
THE QUICKELS ELEKTRODES ADHERE POORLY OR NOT AT ALL	Vacuum pump faulty.	Replace the vacuum pump (QN D100).
	Vacuum hose or patient cable pinched.	Check and repair.
	The primary filter clogged in the Quickels elektrode.	Replace the Quickels elektrode.
	The signal module clogged.	Replace the signal module.
	Leakage in pump or patient module.	See section *Locating leakage in the vacuum system* below.
ONE OR MORE ECG TRACES ARE MISSING	Poor electrical contact between elctrodes and the patient.	Remove the electrodes and add more salt solution.
	Faulty cable.	Check with the Measuring instrument. Replace the patient cable.
50/60 HZ NOISE ON ONE ECG TRACE	Poor electrical contact between elctrodes and the patient.	Remove the electrodes and add salt solution. (See section *Interference on the ECG trace)*
	Salt bridges.	Check with the Measuring instrument. Replace the patient cable.

Troubleshooting guide, contd.

ERROR	CAUSE	SOLUTION
50/60 HZ NOISE ON SEVERAL ECG TRACES	Poor electrical contact with the N-electrode.	Remove the N-electrode and add salt solution.
	EMC disturbing environment.	Make sure no mains connected cables is within the patient environment or in direct contact with the recorder cable and/or control cable. (See section *Interference on the ECG trace*)
MUSCLE INTERFERENCE ON THE ECG	Anxious patient.	Make sure the patient can relax. (See section *Interference on the ECG trace*)
DRIFTING BASE LINE	Uneven vacuum, poor skin contact.	Check that the Quickels electrodes are replaced and that the signal modules are not leaking.
ECG TRACE SENSITIVE TO BODY MOVEMENTS	High static electricity.	If possible, change shoes that are less electrically insulating.
	Damaged shield on patient cable or recorder cable.	Troubleshoot the cable shield. (See section *Resistance of the individual ECG components of the system*)
LEAKAGE	Provided that everything is properly installed; 1. Check that the signal modules are firmly connected to the patient cables. This is easiest done by listening after leakage sounds. 2. Control the system's airflow with the flow meter in the Measuring instrument (QN D750). If the airflow is low; a) Block the exhaust nipple, or squeeze the vacuum hose near the exhaust nipple, while the vacuum is on. Listen for leakage in the pump unit. b) If not, there may be leakage in the vacuum hose, patient module or one or more of the signal modules. • Leakage in the vacuum hose - Replace the vacuum hose (QN D106), • Leakage in the patient module - Replace the vacuum manifold & ECG-circuit board (QN D302-1), • Leakage in the pump module - Replace the Silencer assembly (QN D104).	

Troubleshooting guide, contd.

ERROR	CAUSE	SOLUTION
THE SYSTEM WILL NOT START AND NO INDICATOR LEDS LIGHT UP WHEN THE PATIENT MODULE'S BUTTONS ARE PRESSED	Connect the power supply, see *No vacuum* above.	Connect the power supply, the battery shall wake up and start charging.
	The battery is in sleep mode.	Connect another patient module, if the system starts up replace the User interface adapter board in the patient module (QN D300).
	Faulty adapter circuit board in the patient module.	Replace the motherboard (QN D140).
	Faulty motherboard.	To restart Decapus® III do the following: 1. Disconnect the system from the mains. 2. Disconnect the USB cable (otherwise the system is programmed not go into sleep alas can not restart) 3. Press the on/off button for 3 seconds. 4. Wait 5 seconds. 5. Press any button on the Patient module to restart the system.
	System without battery: The mains power indicator light is off, power supply is faulty.	Replace the power supply (QN D101).
THE SYSTEM'S BATTERY WILL NOT CHARGE	Communication error.	If Decapus® III is connected to the mains and the indicator for mains power is lit on both the power supply and the patient module, but the battery will not charge (indicator on the patient module is not flashing), unplug the power mains cable from the wall socket and re-plug it again.
	The power indicator light on the power supply is off, power supply is faulty.	Replace the power supply (QN D101).

Troubleshooting

LOCATING LEAKAGE IN THE VACUUM SYSTEM

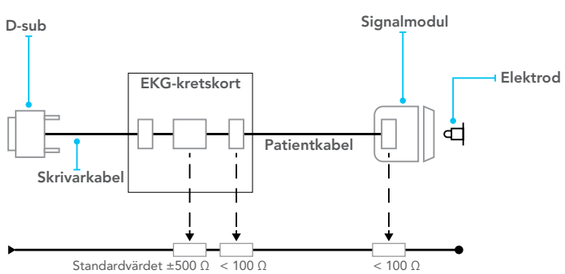
The audible Pump motor speed in vacuum function can be used to determine if there is a leak in the vacuum system. A high pump motor speed is an indication that the system is leaking. Leakage in the vacuum system can be located by incrementally remove more and more parts of the vacuum system closer to the vacuum pump and for each time clog the vacuum hose with a finger while listening to the pump motor speed.

The *Run pump test* in the Service application can preferably be used to detect leakage (see section *Service application (PC), Service Tests*). In case of leakage, see section *Troubleshooting Guide, Leakage*.

RESISTANCE OF THE INDIVIDUAL COMPONENTS OF THE SYSTEM

One way to find errors in the ECG function of the system is to measure the resistance from the electrode to the ECG recorder connector. In order to easily measure the resistance of Decapus® III, see section *Measuring instrument (QN D750)*.

The resistance of the defibrillation protection contributes X kΩ (Default for your model code of Decapus® III, see section *Technical data*), the rubber signal transmittor on the ECG circuit board contributes with a resistance less than 100 Ω and the connector into the signal module contributes with a resistance less than 100 Ω. Other parts of the signaling pathway contributes with a negligible resistance. If the resistance differ from the standard value (see section *Technical data*) with more than 500 Ω, something is wrong in some part of the signal path. Note that this only applies to the ECG signal paths. The resistance of the shield shall be less than 100 Ω between the D-SUB and the shield connector of the patient module (rubber shield transmittor). The shield between the D-SUB and the ECG manifold board shall be less than 3 Ω. The shield is pin 6 on the D-SUB connector on the patient module.



Interference on the ECG trace

First thing to do when encountering a disturbed ECG signal is to determine wether the disturbed ECG signal arises from the Decapus® III or the external ECG printer and not a bad electrical contact to between the electrode and patient.

With normal troubleshooting refers to:

1. Check the Quickels electrode, electrolyte and placement of the Quickels electrodes

2. Check by using the printer switch which channel is incorrect

ECG measurement can be affected by many factors in the measuring environment. It could for example be any of these factors:

- The static electricity in the room is high.
- Mains cables (50/60 Hz) in the patient environment or in close proximity to the recorder cable.
- Mains cables in a wall near the patient (50/60 Hz).
- It is also assumed that the six initial assessments described in the introduction of section *Troubleshooting guide* has been completed.

IRREGULAR BASE LINE

Typical curve with irregular base line is probably caused by fluctuating vacuum level. This may in turn depend on leakage in the vacuum system. The stabilization of the skin/electrode interface may affect the base line. This might occur due to excessive movement of the patient which may cause leakage of the electrodes.

The base line normally stabilizes within a few seconds, but stabilization in some cases may take longer, e.g. if the skin is tight (tibia). Attach if possible the electrode on less tight skin. Some notches in the base line are in most cases due to the cause that the skin adjust to a new position with the electrode. If the irregular curvature occurs for a single ECG channel, examine and possibly change the signal module and/or the patient cable. If the irregular curvature occurs for all ECG signals, it is likely leakage in the patient module, vacuum hose, or pump module, see section *Troubleshooting guide, Leakage*.

NO ECG SIGNAL

Typical curve when the ECG signal is missing. If a single ECG channel lacks signal, do the following:

1. Make sure the patient cable is properly connected to the signal module.

2. Replace the Quickels electrodes and try again.

3. Replace the signal module and try again.

4. Measure the resistance of the ECG signal path for the particular ECG trace.

Interference on the ECG trace, contd.

Locate the fault of the high resistance, replace the defective part (patient cable, recorder cable or ECG manifold board), see section *Measuring instruments (QN D750)*.

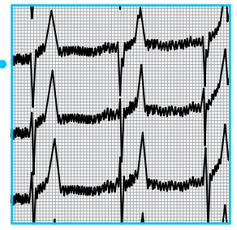
If the measure shows 0 Ω, it is a break in the signal path. Troubleshoot and replace the defective part.

5. Examine the ECG recorder.

If all ECG signals are missing on the ECG trace, you should do the following:

1. Switch Quickels electrodes for R, L and F.
2. Switch signal modules for R, L and F and troubleshoot as in point 4 above.
3. Measure the resistance of R-, L- and F- leads, see section *Measuring instrument (QN D750)* and point 4. above.
4. Examine the ECG recorder.

DISTURBANCES CAUSED BY THE MAINS SUPPLY



Typical curve with superimposed 50 or 60 Hz disturbance from the mains supply. If interference occurs only on one ECG channel you should do the following:

1. Replace Quickels electrode and try again.
2. Replace signal module and try again.
3. Examine the measuring environment.
4. Look for salt bridges (isolation measurement).
5. Measure resistance of specific ECG trace, see section *Measuring instrument (QN D750)*.

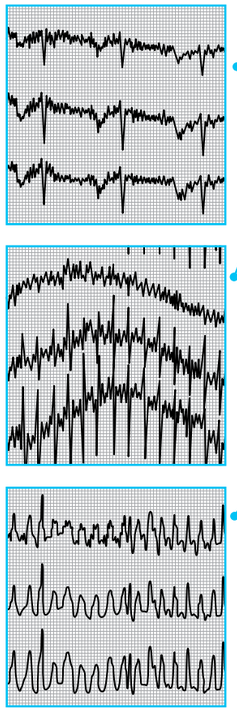
If interference occurs on all ECG channels, you should do the following:

1. Check for 50/60 Hz interference sources nearby.
2. Switch Quickels electrodes of the N-path (R, L and F).
3. Switch signal modules for the N-path (R, L and F).
4. Measure resistance of the ECG signal of the N signal (R, L and F). Locate the fault of a high resistance, replace the defective part (patient cable, ECG manifold board or recorder cable), see section *Measuring instruments (QN D750)*.
5. Conduct isolation measurement between patient leads and shield N-path (R, L, and F), see section *Measuring instruments (QN D750)*.

The resistance between the lead and each ECG channel should be >30 MΩ.

6. Examine the ECG recorder.

Interference on the ECG trace, contd.



SUPERIMPOSED DISTURBANCES WITH A FREQUENCY OF 1 HZ TO 50 HZ

These disturbances are probably caused by the movement of the patient's muscles, which can indicate that the electrodes are placed in a less favourable position. Relocate the electrodes.

DRIFTING BASE LINE WHEN RECORDING ECG STRESS TEST

Typical curve where the base line wander during the measurement. This form of disturbance is normal when performing a stress test.

When the patient starts to sweat there is a dramatic and usually much uneven change in skin impedance. This is normal interference and can only be remedied by puncturing the upper level of the skin. Usually these disturbances subsides and disappearance when the perspiration becomes constant and widespread.

ECG SIGNAL IS SENSITIVE TO BODY MOVEMENTS

Typical recording when the ECG signal is sensitive to movements, both patient movement and movements of people in the room. This type of problem suggests that the electrical shielding is faulty in some way. If the disturbance is present on a single ECG signal, try the following:

1. Measure the resistance of the shield from the recorder cable's D-connector to the shield of the patient cable. See section *Troubleshooting, Resistance of the individual components of the system*.

If the disturbance is dominant on an ECG channel but present on the others, the cause could be that there is something wrong with the shield of the signal path used as reference. Try the following:

1. If you are using the Wilson method, change over to the CR method. If the disturbance is unaffected, you should measure the resistance of the signal path for which the disturbance is dominating. If the disturbance changes such that it is only visible on one of the ECG channels, you should measure the resistance of the shield of this signal path.

If the disturbance is present on all ECG channels it might be caused by electrostatic discharge. Try and change to less isolated foot ware and the problem might resolve.

IRREGULAR DISTURBANCES OF THE ECG SIGNAL

Uneven disturbances can be caused by a high static charge in the room and too much fluid in or around the electrode. Wipe off the excess liquid on the patient. Switch Quickels electrode, check that the signal module is not full of liquid and that no fluid is absorbed into the patient cables.

Also note that all motion affects the ECG signal. If individuals or objects are moving in the room, the electric charge is altered, which affect the ECG signal, therefore, the operator should not move whilst recording the ECG.

Repairs and parts replacement

Before you start work, ensure that the entire Decapus® III system is de-energized by:

1. Unplug the power supply from the pump module.
2. Unplug the recorder cable from the ECG printer.

Note that some parts, the motherboard and the adapter circuit board still are energized if Decapus® III is equipped with a battery. Be sure not to short circuit boards with metal objects, alternatively disconnect the battery as well. The circuit boards are sensitive to electrostatic discharge, ESD, which means you must ensure that you have adequate protection against such discharges before handling circuit boards.

PUMP MODULE

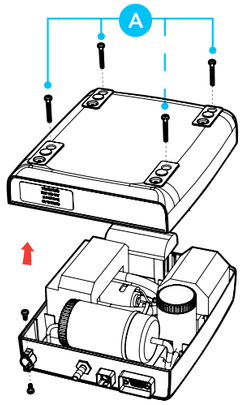
1. Open the pump module casing

a) Turn of Decapus® III.

Make sure to work with the pump module without weighting the system cablings. The control cable may have to be dismantled from the pump module.

b) Turn the pump module upside down and unscrew the four screws A. Then carefully lift up the bottom casing.

c) Assemble in reverse order.



2. Installing/replacing the battery

a) See above: *1. Open the pump module casing* then,

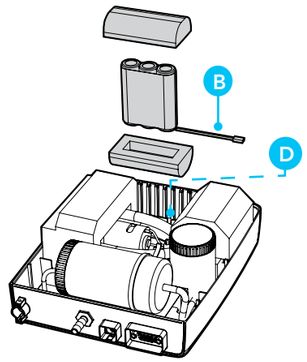
b) When replacing the battery, the battery cable B is to be disconnected from connector C (right side of the motherboard), the battery and support can then be lifted. (See picture on next page).

c) Press the new battery into the supplied support with battery cable B downwards, facing to the right and then place into the casing.

d) Connect the battery cable B in the connector C (right side of the motherboard).

e) Check that the battery cables smoothly goes through notch D in the casing and do not get pinched when the bottom casing is mounted.

f) Connect the plug (power supply) to Decapus® III. Charge the battery fully (≥ 3 h) before the system is operational.



⚠

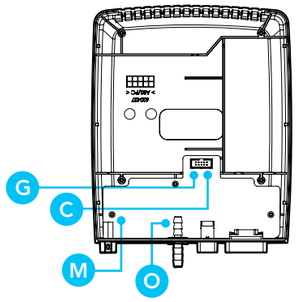
Charge the battery before it is operational.

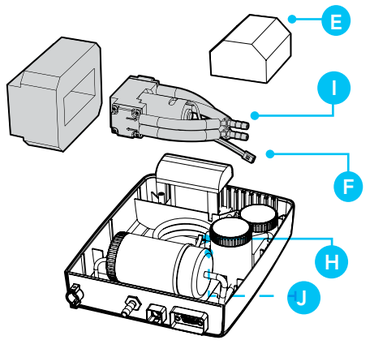
The battery is put in a sleep mode when delivered.

⚠

Never use other than intended battery!

Repairs and parts replacement, contd.





3. Replacing the vacuum pump

a) See above: *1. Open the pump module casing* then,

b) Lift the support E.

c) Disconnect the vacuum pump cable F from connector G (left side of the motherboard).

d) Disconnect the two vacuum hoses H (on the silencer assembly J) from the Y-nipples I wherein the vacuum pump with support can be lifted.

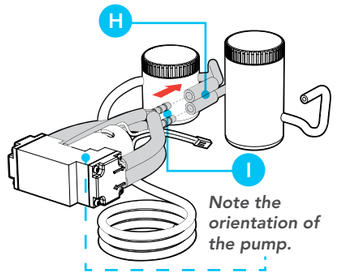
e) The new vacuum pump is pressed into the supplied support and placed in the casing.

f) Connect the pump cable F in connector G (left side of the motherboard).

g) Connect the two vacuum hoses H in into the vacuum pump's Y-nipples I.

h) Place the support E on top of the small plastic jar in the silencer assembly, next to the battery.

i) Check that the vacuum hoses H smoothly go through the notch J in the casing and do not get pinched when the bottom casing is mounted.



4. Replacing the motherboard

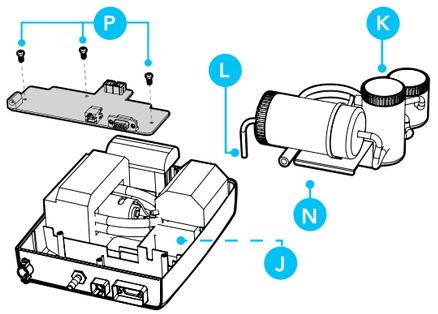
a) See above: *1. Open the pump module casing* then,

b) Lift the silencer assembly K, and disconnect the hose L from the pressure sensor M on the motherboard and hose N from vacuum nipple O. Cable tie and aluminum support retain mounted on the large plastic jar.

c) Disconnect the battery cable B and the vacuum pump cable F from connectors C and G on the motherboard.

d) Unscrew the three screws P and remove the motherboard.

e) Place the new motherboard in the casing and secure it with the three screws P.



f) Connect the battery cable B and the vacuum pump cable F to connectors C and G on the new motherboard. Connect the hose L to the pressure sensor M on the new motherboard and hose N in the vacuum nipple O. Place the silencer assembly K in the casing.

g) Check that the vacuum hoses smoothly go through the notch J in the casing and do not get pinched when the bottom casing is mounted.

When replacing the motherboard, the new motherboard must be loaded with the system's existing serial number. This is done with the Service application.

Repairs and parts replacement, contd.

5. Replacing the silencer assembly

a) See above: *1. Open the pump module casing* then,

b) Lift the support E.

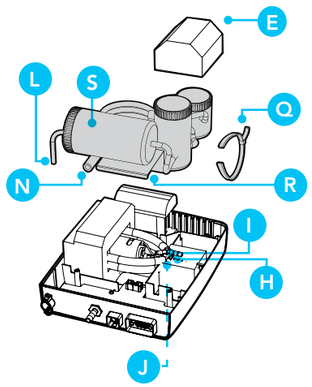
c) Lift the silencer assembly and disconnect the hose L from pressure switch M on the motherboard and hose N from the vacuum nipple O.

d) Disconnect the two vacuum hoses H from the Y-nipples I on the vacuum pump, wherein the silencer assembly can be lifted (see section *4. Replacing the motherboard*).

e) Cut the cable tie Q. Fixate a new cable tie around the aluminum support R and the large plastic jar S in the new silencer assembly.

f) Connect the new hose L to pressure switch M on the motherboard and the new hose N in the vacuum nipple O. Connect the two new vacuum hoses H in the vacuum pump's Y-nipples I. Place the new silencer assembly in the casing.

g) Place the support E on top of the small plastic jar in the silencer assembly, next to the battery.



i) Check that the vacuum hoses smoothly go through the notch J in the casing and do not get pinched when the bottom casing is mounted.

PATIENT MODULE

1. Open the patient module casing

a) Turn of Decapus® III.

Make sure to work with the patient module without weighting the system cablings. The patient module may have to be dismantled from the arm, by removing the cable clips fixating the cablings.

b) Turn the patient module upside down and unscrew the two screws T_1 as well as the four screws T_2. Then carefully lift up the back casing.

c) Assemble in reverse order.

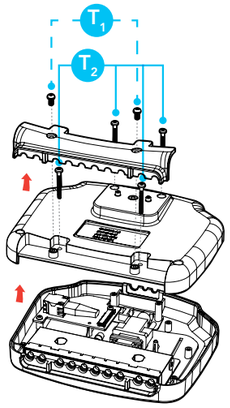
2. Replace control cable/recorder cable/vacuum hose

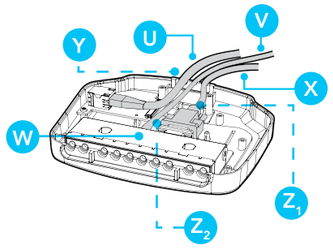
a) See above: *1. Open the patient module casing* then,

b) Cut the cable tie Z_1 and disconnect the control cable U from the adapter circuit board and the pump module (see section *Installing, 2. Pump module*) and replace with new control cable. Mount a new cable tie around the control cable and recorder cable.

Cut the cable ties Z_1 and unscrew the recorder cable X from the ECG circuit board and the external ECG printer and replace with the new recorder cable, and a new cable tie around the control cable and recorder cable.

Cut the cable tie Z_2 and pull the vacuum hose V from the vacuum nipple on the vacuum manifold W and cut it loose from the pump





Repairs and parts replacement, contd.

module nipple. Replace with a new vacuum hose and cable tie. For mounting on the pump module nipple, see section *Installation 2. Pump module*.

c) Check that the control cable, recorder cable and vacuum hose smoothly go through the notch Y in the casing and do not get pinched when the back casing is mounted.

3. Replace adapter circuit board

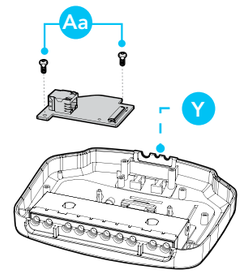
a) See above: *1. Open the patient module casing* then,

b) Disconnect the control cable U and the flexible flat cable from the adapter circuit board.

c) Unscrew the two screws Aa and remove the adapter circuit board.

d) Place the new adapter circuit board in the casing and fasten it with the two screws Aa.

f) Connect the control cable U and the flexible flat cable to the new adapter curcuit board.



g) Check that the control cable, recorder cable and vacuum hose smoothly go through the notch Y in the casing and do not get pinched when the back casing is mounted.

4. Replace ECG circuit board and vacuum manifold

a) See above: *1. Open the patient module casing* then,

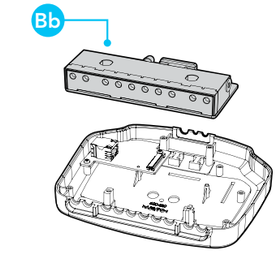
b) Cut the cable ties Z_1 and Z_2, and disconnect the control cable U and the recorder cable X from the ECG circuit board and vacuum hose V from the vacuum manifold.

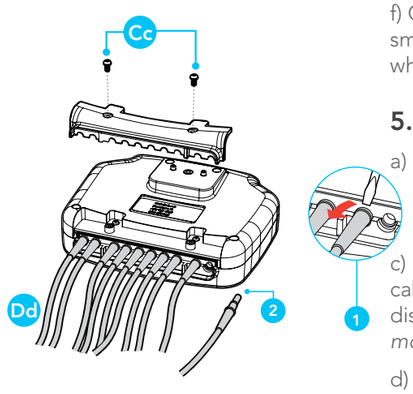
c) Detach the patient cables Dd (see below *5. Replace patient cables*).

d) Remove the ECG circuit board and vacuum manifold Bb.

e) Place the new ECG circuit board and vacuum manifold in the casing and connect the recorder cable X and vacuum hose V. Fasten the cable ties (see *2. Replacing control cable/recorder cable/vacuum hose*).

f) Check that the control cable, recorder cable and vacuum hose smoothly go through the notch Y in the casing and do not get pinched when the back casing is mounted.





5. Replace patient cables

a) Unscrew the two screws Cc and lift up the hatch.

b) Detach the patient cables Dd by first gently lever (1) with a small screwdriver.

c) Install the new patient cables. Note that the marking on the patient cable's signal module end shall be consistent with the position displayed by the marking panel on the patient module (see *Patient module*).

d) Screw on the hatch.

Repairs and parts replacement, contd.

6. Replace signal modules

a) See section *Installation, 4. Signalmodules and electrodes.*

7. Replace Quickels electrodes

a) See section *Installation, 4. Signalmodules and electrodes.*

8. Replace the arm

a) See section *Installation, 1. Patient module and arm.*

⚠
Qualification to perform service

Service must only be performed by qualified personnel.

⚠
Caution

Decapus® III must not be sterilised or immersed in fluids. Neither should fluids be allowed to be sucked through the system.

⚠
Annual service

If the hospital or institution do not adopt an acceptable schedule for cleaning and inspection of this equipment, it may result in equipment failure and health hazards. Annual maintenance should be performed by qualified personnel.

Technical data

GENERAL	Safety	MDD Classification Class IIa IEC 60 601-1 class I, type CF, with defibrillation protection.
ENVIRONMENTAL REQUIREMENTS	Ambient temperature	In operation: +10 to + 40°C. In storage -10 to +40°C
	Relative humidity	25-95%, no condensation
	Air pressure	700-1060 mbar
PUMP MODULE	Power consumption	Max 35 W
	Negative pressure	0-600 mbar
	Airflow	7.5 litres/min at the patient end
	Measurement	H 100 mm, L 240 mm, W 180 mm
	Weight	1.1 kg
PATIENT MODULE	Defibrillation protection	10 kOhm with surge protection 140 V
	Rapid negative pressure selection	120, 200, 240, 280 mbar
	Measurement	H 30 mm, L 110 mm, W 135 mm
	Weight	1.1 kg
POWER SUPPLY	Model	XP Power Model: AFM 45US15
	Mains voltage and frequency	100-240 V, 50 or 60 Hz
	Current rating	Max 1.1 A
	AC input	IEC-320-C14
	Classification	Class I, according to IEC 60 601-1
CABLES	Printer cable	2.7 m, DA-15 plug/socket
	Control cable	2.8 m, DE-9 plug/socket
	Vacuum hose	2.8 m
PATIENT CABLE	Length	Extremities: 1.2 m. Chest: 1.0 m
	Tensile resistance	Minimum 50 N
QUICKELS ELECTRODE	Material	Ag/AgCl sensor, fulfils recommendations of AAMI. Biocompatibility and toxicology studies in accordance with biocompatibility: In vitro cytotoxicity ISO 10993-5, Skin irritation ISO 10993-10 and Allergy ISO 10993-10.
BATTERY	Battery pack (option)	Rechargeable Li-ion battery 11.1 V, capacity 2.6 Ah
	Manufacturer	Quickels Systems AB, Catalogue number: QN D103
	Lifetime	Approximately 400 charging cycles
	Charging	Charging time approximately 2 hours
SIGNAL IN/OUT PUMP MODULE	Control cable input	DE-9 socket/plug
	USB input	USB B socket/plug
	DC input	DC plug
STAND	Length of folding arm	570/650 mm
	Table fixation	Clamp measurement 10-130 mm
SERVICE APPLICATION	Software	Compatible with Windows XP, 7 and 8

Changes may occur without prior notice.

Technical data, contd.

OPERATOR PROFILE	Clinics with ECG training, health centre workers, hospitals or private care centres. Must understand the language used in the user manual.
INTENDED USE	Record ECG signals from the patient and transfer these to an ECG printer, for the purpose of discovering/checking various types of deviant heart rhythms. The system is intended for recording rest and stress ECG, although not for longer than 40 minutes.
NORMAL USE	Normal use means about 25 resting ECGs per day (5 min per round).
PATIENT GROUP	From 5 years. Not intended for patients with open wounds or other major skin damage in the regions where Quickels electrodes are applied.
SYSTEM LIFETIME	10 years.
OTHER	Materials in the Quickels electrodes and signal modules do not contain latex. The material in the patient module and pump module covers is made of ABS/PC plastic.

Spare parts and accessories

QN-NR	PRODUCT NAME
QN PUM-A-B	Pump module D3 CPL
QN D100	Vacuum pump assembly
QN D140	Motherboard (circuit board)
QN D103	Battery assembly
QN D104	Silencer assembly
QN D105-A	Pump module casing top
QN D106	Pump module casing bottom
QN PAM-A-C-D-E-F	Patient module D3 CPL
QN D300	User interface adapter board (circuit board)
QN D302-1	ECG manifold board (circuit board) & Vacuum manifold assembly
QN D301-A	Patient module casing front
QN D303	Patient module casing back including hatch
QN D13SC	Recorder cable 1.3 m Schiller
QN D13SI	Recorder cable 1.3 m Siemens
QN D27SC	Recorder cable 2.7 m Schiller
QN D27SC_R	Reversed recorder cable 2.7 m Schiller
QN D27SI	Recorder cable 2.7 m Siemens
QN D27SI_R	Reversed recorder cable 2.7 m Siemens
QN D27WA	Recorder cable 2.7 m Welch Allyn
QN D27TP	Recorder cable 2.7 m TEPA
QN D40SC	Recorder cable 4.0 m Schiller

Spare parts and accessories, contd.

QN-NR	PRODUCT NAME
QN D40SI	Recorder cable 4.0 m Siemens
QN D310-1	Control cable 2.8 m
QN D310-2	Control cable 3.1 m
QN D311-1	Vacuum hose 2.8 m
QN D311-2	Vacuum hose 3.1 m
QN D111	Power mains cable
QN D101	Power supply (XP Power Model: AFM 45US15)
QN 410	Patient cable 1.0 m
QN 420	Patient cable 1.2 m
QN 440	Patient cable 1.4 m
QN 400-1	Precordial leads 6x1.0 m; Limb leads 4x1.2 m
QN 400-2	Precordial leads 6x1.0 m; Limb leads 4x1.4 m
QN 400-3	Precordial leads 6x1.2 m; Limb leads 4x1.4 m
QN 600	Arm assembly
QN 601	Table fixation
QN 602	Patient module holder
QN 603	Cable clip kit
QN 604	Electrolyte spray assembly
QN 606	Signal cable retainer
QN 726	Wall attachment with plate
QN 793	Arm attachment

Spare parts and accessories, contd.

QN-NR	PRODUCT NAME
QN D796	Arm attachment Schiller Kangaroo
QN 500	Quickels-electrodes
QN 509	Signal module (10 pcs.)
QN 510	Signal module (1 pc.)
QN 511	Marking rings (10 pcs.)
QN 512	Marking labels (10 pcs.)
QN D107	USB protection lid
QN D129	Vacuum connector
QN D133	Rubber foot (4 pcs.)
QN D701	Pump attachment
QN D750	Measuring instrument incl flow meter
QN D305-H/QN D752	ECG adapter assembly Ask *Quickels Systems AB for compatible ECG printers.*

Changes may occur without prior notice.